1.2: Classifying and Storing Data

- The collection of data is called a **data set** or a **sample**. The **population** refers to the set or group that contains everything relevant to the data.
- When we collect data, the characteristics of that data (e.g. gender, weight, temperature) are called **variables**.
- Variables can be categorized into two groups:
  - Numerical variables
  - Categorical variables

Example. The following table contains data crash-test dummy studies.

- How many variables does this table have?
- How many observations does this table have?
- For each variable, identify whether it is numerical or categorical:

Make	Model	Doors	Weight	Head Injury
Acura	Integra	2	2350	599
Chevrolet	Camaro	2	3070	733
Chevrolet	S-10 Blazer 4X4	2	3518	834
Ford	Escort	2	2280	551
Ford	Taurus	4	2390	480
Hyundai	Excel	4	2200	757
Mazda	626	4	2590	846
Volkswagen	Passat	4	2990	1182
Toyota	Tercel	4	2120	1138

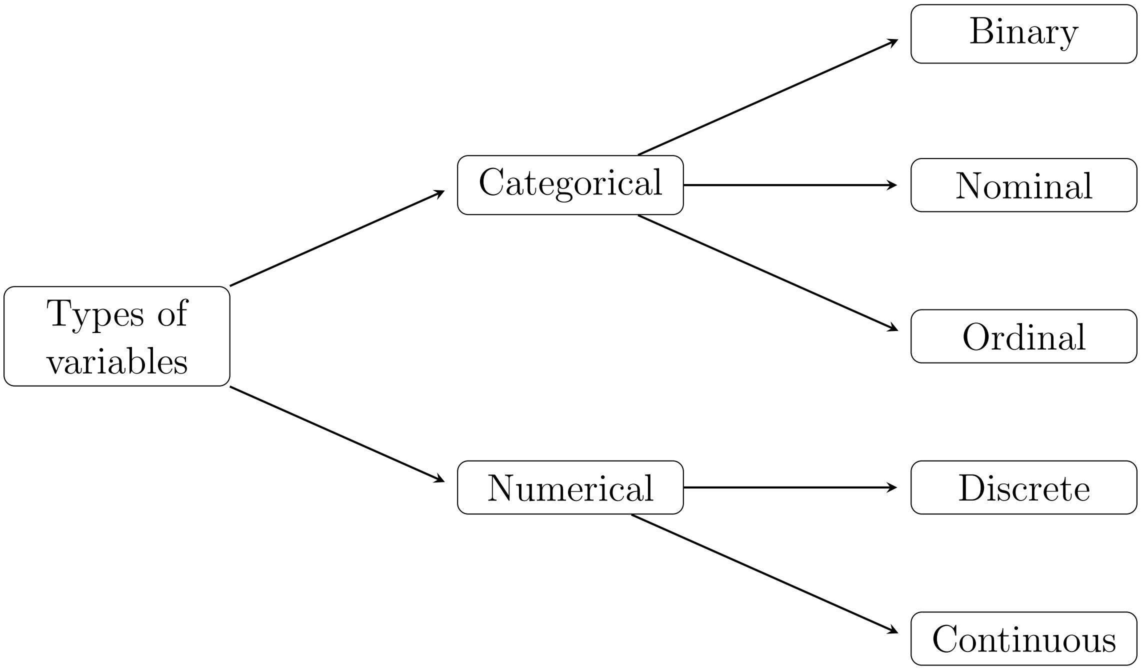
Coding categorical data using numbers:

Weight	Gender	Smoke
7.69	Female	No
0.88	Male	Yes
6.00	Female	No
7.19	Female	No
8.06	Female	No
7.94	Female	No

$\longrightarrow$

Weight	Female	Smoke
7.69	1	0
0.88	0	1
6.00	1	0
7.19	1	0
8.06	1	0
7.94	1	0

We can further break down variables into five types:



Example. Suppose a local store was interested in whether a new product would sell or not. The manager decided to take a random sample of 100 customers over a two-week period and asked each person whether they would buy the product or not and how many times would they buy the product over a six month period.

a) What is the population?

b) What is the sample?

c) What are the variables?

d) Classify each variable as numerical or categorical.

1.4: Organizing Categorical Data

Definition.
In the context of statistics, **frequency** is the number of times a value of a variable is observed in a data set.
Relative frequency (proportion) is a ratio of the frequency of a variable to the total frequency of the group desired. This can be left as a fraction, decimal, or percentage.

Example. The following **two-way table** contains the results of a national survey that asks American youths whether they wear a seat belt while driving or riding in a car:

	Male	Female	Total
Not Always	2	3	
Always	4	8	
Total			

a) Find the total number of males, females, and total participants in this survey.

b) Identify the frequencies, and compute the percentages below:

	Male	Female	Total
Not Always			
Always			
Total			100%

c) Are males or females more likely to take the risk of not wearing a seat belt?

d) Should we use the frequencies or the relative frequencies to make comparisons?

1.5: Collecting Data to Understand Causality

Definition.

- In an **observational study**, we observe individuals and measure variables of interest but do not attempt to influence the responses. (Observe but do not disturb)
- In a **controlled experiment**, we deliberately impose some treatment on (that is, do something to) individuals in order to observe their responses. Researchers assign subjects to a treatment group or control group.
- **Anecdotal evidence** is a story based on someone's experience.

- In an **observational study**, the researcher observes values of the response variable for the sampled subjects, without anything being done to the subjects (such as imposing a treatment).
- In short, an *observational study* merely observes rather than experiments with the study subjects.

Note: Anecdotal evidence and observational studies:

- NEVER point to causality (cause-and effect).
- Only point to an association between variables!

To establish cause-and-effect: Use a controlled experiment!

Definition.
Differences between two groups that could explain different experiences/outcomes are called **confounding variables** or **confounding factors**.

How to design a good experiment ("Gold standard" in experiments):

- Random allocation – participants randomly allocated to treatment and control group
- Use of a placebo if appropriate
  - A **placebo** is a fake treatment (e.g. sugar pill).
  - The **Placebo-Effect** is reacting to a treatment you haven't received.
- Blinding the study – used to avoid bias
  - Single blind – Researcher is unaware of treatment group
  - Double blind – Researcher and subjects are both unaware of treatment group
- Large sample size – accounts for variability